

APPENDIX 1

Alternative Measures

If the conditional concurrence for the referenced project is later treated as an objection, in accordance with 15 CFR Part 930, §930.63 (b), (c), and (d), the Commonwealth would likely propose the alternative measures described below, which if adopted by Dominion, may permit the referenced project to be conducted in a manner consistent with the Enforceable Policies of the Virginia Coastal resources Management Program (VCP). Should the conditional concurrence for the referenced project later become an objection, the VCP may also describe additional alternative measures than those listed below.

Fisheries Management Enforceable Policy

DGIF commented on the Draft EIS for this project in February 2005, and expressed concern that the project may result in significant adverse impacts upon fishery resources in Lake Anna and in the North Anna River downstream. These impacts could result from fish impingement and/or entrainment at the intake, and the increased frequency of drought flows downstream. For these reasons, DGIF indicated that the project, as then proposed, would be inconsistent with the fisheries management enforceable policy of the Virginia Coastal Resources Management Program.

In October 2005, Dominion proposed a new cooling method for proposed Unit 3. The proposed unit would now use a combination wet/dry cooling process instead of once-through cooling, in order to reduce the evaporative losses from the proposed unit. The proposed Unit 4 would use a dry cooling method, as before. The proposed Unit 3 circulating water system would operate in one of two modes:

- Energy conservation (EC), in which the dry cooling process would be turned off, with reliance on wet towers for heat removal
- Maximum water conservation (MWC), in which at least 1/3 of the heat would be removed by the dry towers, while the rest would be removed, as required, by the wet towers

DGIF's additional discussion concerns the revised design as it would affect resources under its jurisdiction, and includes recommendations for mitigating potential adverse impacts on the resources. The issues listed below relate to striped bass reservoir habitat, water intake systems for the plant, and hydrologic alterations. These comments are based on DGIF's review of the "Revision 7" document submitted by Dominion in June 2006.

Striped bass reservoir habitat According to DGIF, the proposed wet-dry cooling system for proposed Unit 3 would not increase heated water in the Lake, as the heat would be dissipated through the cooling towers with only a minimal amount returned to the Lake. Accordingly, DGIF does not expect the new design to cause changes in striped bass habitat.

Intake systems The current intake screen at the plant has a 9.5 mm mesh size and an intake velocity of 0.7 feet per second (fps). The same design is proposed for Unit 3. With the

re-design of Unit 3's cooling process, the expected impingement and entrainment rates are expected to be much lower, as indicated here:

Cooling Method	Number Impinged	Number Entrained
Once-through	240,000 annually	147 million annually
Proposed wet-dry	5,400 annually	3.4 million annually

Mesh size and intake velocity: Analysis Earlier DGIF recommendations were for a mesh size of 1 mm and an intake velocity of 0.25 fps. Based upon discussions regarding a lack of sweeping velocity in a reservoir situation, and further literature search, DGIF determined that a 9.5 mm mesh size would only exclude fish larger than 3.4 inches from the intake. A 2 mm screen mesh size will exclude fish larger than 1 inch from the intake.

Recommendations: DGIF recommends a 2 mm mesh size and an intake velocity of 0.5 fps for the new Unit 3 and Unit 4. This recommendation differs from DGIF's earlier recommendation and also from the applicant's existing practice and proposed measurements. Here is a comparison of the recommendations:

	DGIF Earlier Recommendation	DGIF Present Recommendation	Applicant's Proposal (same as for existing units)
Mesh size	1 mm	2 mm	9 mm
Intake velocity	0.25 fps	0.5 fps	0.7 fps

Hydrologic Alterations: Analysis The proposed new cooling method for Unit 3 leaves DGIF with some remaining concerns regarding increased evaporation from Lake Anna and subsequent impacts upon downstream hydrology. These concerns can be addressed by changing the proposed operating rules for implementation of the Maximum Water Conservation (MWC) mode cooling process. The concerns are that the increased frequency of flows below 40 cubic feet per second (cfs) will cause the downstream hydrology to change to a drier condition than would occur naturally, resulting in lower flows for downstream resources in the Pamunkey River.

The required release flow of 40 cfs is 11.6% of mean annual flow (MAF). Normal summer flows on a stream this size would be from 70 to 100 cfs or 20-30% of MAF. Reduced flows result in reduced summer habitat for resident species as well as downstream migratory species. An analysis of Dominion's long-term North Anna River monitoring data demonstrated that the fish community requires a diverse flow pattern, with different species doing best in wet years. This is similar to study results from the James River and the North Fork, Shenandoah River.

Frequency of 20 cfs flows The normal water elevation of the Lake is 250 feet above mean sea level (msl). Current operating rules for the North Anna Power Station allow flows to be reduced from a required 40 cfs to 20 cfs whenever the lake elevation reaches 248 feet msl. Prior to lake construction, flows were less than 20 cfs 4.2% of the time; currently, flows are decreased to 20 cfs 5.2% of the time. With the proposed Unit 3 wet/dry cooling system, the frequency and duration of these events would increase to 7.3% of the time. This is an improvement over the original proposal (2003-2005), which would have resulted in flows being reduced to 20 cfs 11.7% of the time.

With the existing two units, there are two (2) 20-cfs flow events predicted over 24 years. The proposed Unit 3 would increase that to five (5) such events. The addition of the proposed Unit 3 would also increase the duration of the first two 20-cfs events by an additional 4 to 5 weeks. The three (3) additional events have durations of 2 to 13 weeks.

Recommendations: For each additional inch of water stored, an additional 27 days are provided during which flows can be maintained at 40 cfs. By storing 3 inches of water, resulting in a lake elevation of 250.25 feet msl, the five (5) events of 20 cfs would be reduced to three (3) such events, and the duration of the third event would be reduced from 13 weeks to 1 week. The other two events would have the same duration as they previously did. Accordingly, the DGIF recommends that the normal operating elevation be seasonally increased (from April through November) to 250.25 feet msl in order to minimize the impacts of an increased frequency and duration of 20-cfs flows on downstream resources. Rules could be put in place to reduce the pool to 250 feet msl prior to predicted severe storm events such as hurricanes and tropical depressions.

Altered Flow regime above 40 cfs The proposed Unit 3 will withdraw a maximum of 49.6 cfs, with an average use of 34.3 cfs. Return water could range from near zero to 49.6 cfs, depending on the operation of the dry cooling unit and ambient air temperature. Under summer conditions, dry tower return rates could be in the range of 25%. Winter returns could be 100% with minimal evaporative loss from the lake. Use of only the wet tower, however, would result in almost 100% evaporative water loss. The table offered by the DGIF ("Table 1," attached to the Department's July 7, 2006 comments, enclosed) summarizes the flows of the North Anna River under four conditions:

- prior to construction of Lake Anna;
- under current conditions;
- with the addition of Unit 3 as proposed; and
- with the MWC mode utilized.

According to DGIF, some discrepancies appear in the table because Unit 3 values were computed using weekly averages instead of daily values (see the spring months during median (50th percentile) and 75th percentile events, when flows with Unit 3 are shown as being higher than existing values.

It is recognized that creation of Lake Anna improved water quality downstream from Contrary Creek, which has benefited several fishery resources. During dry conditions in late summer (10th percentile), some flows now are slightly higher than before (see Table 1). However, for most of the time since creation of the Lake and operation of the power plant, there has been a negative impact on flows: almost all monthly percentile flows are less due to natural and accelerated water evaporation.

In managing an aquatic resource, low, normal, and high flows are important for various species. Naturally variable flows result in a balanced and diverse fish community. Changes in flow of more than 10% can produce habitat changes of 10%. DGIF has highlighted, in Table 1, those instances where:

- Natural flows have been reduced by more than 10% of the pre-Lake flows; and
- Use of the MWC mode would increase post-Unit 3 flows by more than 10%.

Use of the dry cooling system in the summer could also be effective in helping create seasonal variation during wetter years.

Hydrologic Alterations: Additional Considerations According to DGIF, some of the most biologically important fishery resources and most critical seasons are as follows:

- **Herring spawning during March** Based upon results on the Rappahannock and James Rivers, herring runs are strongest when flows are near normal. Low flows have resulted in reduced numbers moving upstream.
- **Shad spawning during late March and April** Upstream migration is less during dry years.
- **Smallmouth bass spawning in May and June and juvenile bass development and survival during June.** Statewide, DGIF has documented that juvenile bass survival is highest when June flows are between the median and average values. June flows (Table 1) are currently below median values and would decrease more with the addition of Unit 3, to 43% of pre-Lake values. Water conservation during this period should enhance smallmouth bass juvenile survival.
- **Juvenile shad survival on the Pamunkey River is best during wet summers** The Pamunkey system has the healthiest shad population in Virginia and serves as the brood source for shad re-establishment in the James River system. DGIF has reviewed the impacts of stream flow on American shad juvenile production in the Pamunkey River. These data were presented to Dominion and the Nuclear Regulatory Commission in separate meetings in spring 1006. Shad juvenile year class strength and survival were assessed by evaluating catch-per-unit effort of returning brood stock, ages 4 to 6 years. In summary, the best juvenile shad survival occurred during wetter June-to-August years (those with flows at the 80th percentile). Lake Anna is about 1/3 the drainage area of the Pamunkey River at the gauge station near Hanover, and is an important contributor to that River's flow. Flow losses within Lake Anna due to evaporation can have a significant impact upon downstream shad resources.

Recommendations. The Department of Game and Inland Fisheries recommends the following operating rules for implementation of the Maximum Water Conservation (MWC) mode associated with proposed Unit 3:

- **In March and April,** DGIF recommends implementation of the MWC mode when flows are less than 225 cfs. Flows are in the lower quartile, and water conservation savings can result in significant habitat savings and return flows to near-existing conditions. These flows are particularly important for herring, shad, migratory striped bass, and resident sucker and minnow spawning.
- **In May,** DGIF recommends implementation of the MWC mode when flows are less than 175 cfs. These flows are important for smallmouth bass nesting. The addition of Unit 3 would reduce flows by 30% from pre-Lake conditions.

- **In June**, DGIF recommends implementation of the MWC mode when flows are less than 120 cfs. This value is close to the average value and will enhance smallmouth bass spawning success and subsequent catch by anglers.
- **From July through October**, DGIF recommends implementation of the MWC mode when flows are less than 90 cfs. High flows are important for the habitat requirements of resident fish species that do best in wet years. Without water conservation in wet years, those optimal habitat conditions are not achieved. Wet years are also important for producing strong year classes of shad in the Pamunkey River.

Finally, under the current proposal by Dominion, the MWC mode would be implemented after a 7-day waiting period when water surface elevation is below 250 feet msl and releases are 40 cfs. DGIF recommends against the 7-day waiting period before implementing water conservation. DGIF recommends in favor of implementation when downstream flows have a 3-day rolling average at the above triggers (below 250 feet msl, releases of 40 cfs).

DGIF Comments following later meetings In an August 28 e-mail (Kauffman to Joseph Hassell (DEQ), Andrew Zadnik (DGIF), and Gary Martel (DGIF), DGIF staff contemplated differences between Dominion's Revision 7 and the SDEIS. The foregoing DGIF comments are based on Revision 7. It appears that Dominion based its analysis on weekly averages using the downstream gauge and historic lake levels. NRC based its analysis, in the SDEIS, on computed daily inflow via a surrogate gauge station on the Little River just downstream of the Lake.

The earlier NRC document, the Draft EIS, predicted lake level would be at an elevation of 248 feet msl 11.8% of the time. The SDEIS predicted that this level would be met 11% of the time, whereas the Revision 7 document predicts that this level would be met 5.2% of the time. These differences can be depicted in a chart, as follows:

	NRC DEIS	NRC SDEIS	Dominion Rev. 7
Max. water loss	11,700 gallons per minute (gpm)	11,532 gpm	
Wet cooling water loss		16,695 gpm	
Lake level at 248 feet msl	11.8% of time	11% of time	5.2% of time
Number of low-flow events		2 events -> 9 with Unit 3	2 events -> 5 with Unit 3

DGIF used the Dominion numbers (Revision 7) in its July 7 analysis (above). DEQ's Division of Water Resources staff responded to these reflections by stating that it is incumbent upon Dominion to explain the differences, and recalled that the Dominion-NRC assumption was that air-cooling would be employed whenever lake levels dropped below 250 feet msl. DEQ's Division of Water Resources had previously recommended going to air cooling more often than when the lake level hits 250 feet; if this recommendation prevails, then both Dominion's and NRC's estimates of consumptive use will be high.

Point Source Pollution Control Enforceable Policy

The point source program is administered by the State Water Control Board pursuant to § 62.1-44.15 of the *Code of Virginia*. Point source pollution control is accomplished through the

implementation of the National Pollutant Discharge Elimination System permit program established pursuant to Section 402 of the federal Clean Water Act and is administered in Virginia as the Virginia Pollutant Discharge Elimination System (VPDES) permit program.

DEQ's Division of Water Resources stated that its concerns centered on the difference between the Division's recommendations on when to use air cooling for Unit 3 and the proposed regime in the revised Early Site Permit application submitted by Dominion. Dominion propose in its revised application to operate Unit 3 in its water conservation mode (air cooling) whenever the water level in Lake Anna falls below 250 feet above mean sea level ("250 feet msl"). The Division, along with the Department of Game and Inland Fisheries, recommended that in addition to this approach, the water conservation mode be employed for Unit 3 whenever stream flows in the North Anna River immediately below the dam were below certain target seasonal flows, in order to reduce withdrawals required for operation of Unit 3 and to mitigate impacts to stream flows during these periods.

The Division's original concerns have been largely addressed by the changes made by Dominion for cooling Units 3 and 4, and by discussions between program offices in DEQ. The proposal to operate air cooling (maximum water conservation mode) only when the lake level drops below 250 feet msl means that the air cooling would be implemented during times when it is least effective, i.e., during summer through late fall.

Recommendations: Notwithstanding the Division's concerns about the effectiveness of this maximum water conservation mode during summer to late fall, the maximum water conservation mode is warranted whenever the lake falls below a full condition. Water savings will accomplish the following:

- Reduce the ultimate lake drawdown
- Benefit lakefront property owners
- Shorten the time between more normal releases
- Reduce the risk of shutdown of the plant

DEQ's Division of Water Resources agrees that Unit 3 should be operated in this fashion at a minimum (see enclosed DEQ memos, Hassell to Ellis, dated July 19, 2006 and Hassell to Ellis, dated October 19, 2006). However, it may not be realistic to require this operating scheme in the context of the federal consistency review, according to the Division.

A future water resources permit (see item 2(c), next) will, according to the Division of Water Resources, include conditions reflective of the Division's July 19 recommendations.

Water Resources Permitting The Division of Water Resources was initially concerned by the uncertainty about whether a Virginia Water Protection Permit (VWPP) would be required for water withdrawal impacts. The VWPP is the primary controlling mechanism for regulation of impacts due to surface water withdrawals. However, the VPDES permit may also be used for this purpose. The current VPDES permit for the North Anna Power Station contains minimum flow conditions and would need to be modified if Unit 3 were built. DEQ can require Dominion to abide by combined recommendations of the Division of Water Resources and the Department of Game and Inland Fisheries through a lawfully issued VPDES permit.

Policy Issues and Questions: Additional Analysis by DEQ's Division of Water Resources and Northern Virginia Regional Office.

Cumulative Impacts. According to DEQ-DWR, the use of air cooling only after lake levels begin to decline has been changed to more reliance on air cooling. This will reduce the time that the lake level will be down more than 2 feet (i.e., at 248 feet msl) from 11% of the time in an earlier proposal to 7% of the time with the present proposed configuration. By operating the third unit to take maximum advantage of air cooling, Dominion can minimize adverse impacts of the third unit on middle-range flows to an acceptable level.

Foreclosure of Development of Public Water Supplies in the Region. As discussed further in enclosed comments and in the "Review of Public Comments," below, following is a listing of the status of water supply efforts in neighboring localities:

Locality	Efforts	Impact on Lake Anna/N. Anna River or from Project
Caroline County	Pursuing tidal intake from Rappahannock River	No impact on flows in York River basin
Hanover County	Purchases from Richmond, water skimmed from high river flows, use of quarry	No indication
Town of Orange	Water supply reservoir completed, water from Rapidan River	Net gain to region from inter-basin transfer
Spotsylvania County	Spotsylvania did not pursue Lake Anna water	No indication
Louisa County	Considering purchase from Fluvanna County, which has water withdrawal permit for water from James River; considering existing reservoir	No effect from Unit 3

Raising Lake Level DEQ's Division of Water Resources states that raising the lake level 6 to 9 inches is not under consideration. No decision has been made with regard to a 3-inch increase recommended by DGIF; this would allow an additional 27 cubic feet per second (cfs) to be released into the North Anna River for 60 days each year. This proposal would require VPDES approval in the lake level contingency plan or approval under a VWP Permit.

Blowdown Discharges from Unit 3 According to DEQ's Northern Virginia Regional Office, blowdown discharges from proposed Unit 3 may add heat and chemicals to the "hot side" that may affect water quality. The existing VPDES permit #VA0052451, which applies to Units 1 and 2, would need to be modified to address the cooling tower blowdown discharges attributable to Unit 3. Effluent guidelines specified in federal regulations (40 CFR Part 423) would be used in the permit action, which would also accord with water quality standards. Any added heat would be analyzed to determine whether it warrants a re-evaluation of the existing section 316(a) variance applicable to the North Anna Power Station. Similarly, the VPDES permit action would analyze the use of chemicals to ensure that numeric criteria of state water quality standards are met.